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THE FIRST
BOOK OF BOTANY.

BY MRS. LOUDON.

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THE

FIRST BOOK OF BOTANY.

BEING

A PLAIN AND BRIEF INTRODUCTION
TO THAT SCIENCE,

FOR SCHOOLS AND YOUNG PERSONS.

BY MRS. LOUDON,

AUTHOR OF "INSTRUCTIONS IN GARDENING," "THE
LADIES' FLOWER GARDEN," ETC.

ILLUSTRATED WITH

THIRTY WOOD-ENGRAVINGS.

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PREFACE.

The following pages are intended to explain those terms to the young student which are common to all systems of Botany, and without a knowledge of which it is impossible to understand the descriptions of plants given in any Botanical Work. In most works on Botany, these terms are mixed up with many others, which not being necessary at first, only serve to perplex the young student; and it is therefore trusted that the selection of the most essential given in the following pages, will be useful in forming the first step, from which the student may afterwards advance at pleasure.

When these terms, which may be called the alphabet of the science, have been acquired, it will be comparatively easy for the pupil to study either the Linnean or the Natural System of Botany; and a short sketch of both systems, with an explanation of the principal terms used in each, will be found at the end of the present work.

J. W. L.

Bayswater, Jan. 1841.

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THE

FIRST BOOK OF BOTANY.

INTRODUCTION.

Botany implies a knowledge of plants, including their names and arrangement with relation to each other; their properties and uses; their habits of growth and native countries, and their construction and functions.

Botany thus comprising several distinct departments may be divided into three branches—namely, *Systematic Botany*, which includes the names and classification of plants; *Descriptive Botany*, which relates to their forms, properties and uses, habits of growth, and native countries; and *Vegetable Physiology,* which comprises all that is known of their construction and functions.

Before studying these branches in detail, it is necessary for the student to acquire the language of the science, in which all botanical works are written; and to teach this language is the object of the following pages.

CHAPTER I.

OF THE PARTS INTO WHICH PLANTS ARE DIVIDED BY BOTANISTS.

A Plant is divided by Botanists into—the root, the stem, the leaves, and the flowers, from which last is produced the fruit, which contains the seeds.

THE ROOT.

The root is not only necessary to enable a plant to support itself in the ground, but it is the organ by means of which the plant takes its food. The true roots are fibrous substances, which consist of a number of ring-like cells united to each other, and covered with an elastic skin, which is quite entire, and will permit nothing to enter, or to pass through it. At the end of each *fibrous* root, however, is a part which is not covered with any skin, but which consists of a number of little pores which absorb water like a sponge; and hence this part of the root is called a *spongiole,* or *spongelet,* which signifies a little sponge. Now as the part of the root which is covered with a skin will not admit any liquid to pass through it, and as plants can take no food that is not in a liquid state, they can take no nourishment but what is absorbed by their spongioles; and the moisture that these little sponges suck up, is forced onwards through the roots by the alternate expanding and contracting of the elastic skin, and it is thus sent on from cell to cell, till it arrives at the main body of the plant. This has been shewn by watering a plant with coloured water, and then taking it up carefully, and examining the roots with a microscope. The spongioles may easily be distinguished by the naked eye, as they are whiter and more delicate, and rather thicker than the other part of the fibrous root.

Besides the fibrous roots which serve to suck up moisture out of the earth for the use of the plants, there are some solid substances which are generally called roots, but which botanists consider as underground stems, or buds; and these contain a mass of nourishing feculent matter, which appears to have been laid up by nature for the plants to feed on when they cannot get their proper nourishment from the ground. Of this nature are the *tubers* of the potatoe, which will often send out long shoots in a cellar; the *rhizomas*, or scaly roots of the water-lily; the *tap*, or *fusiform* root of the carrot, and the *globular* root of the turnip, both of which will begin to shoot before they are put into the ground; the *fasciculated tubercles* of the dahlia and the garden ranunculus; the *granular*, or grain-like roots of the lesser celandine, and the mountain saxifrage; the *stoloniferous*, or creeping roots of the couch grass; and all the different kinds of *bulbs*.

Bulbous roots are divided into three kinds—namely, the *solid bulb*, (which is also sometimes called a *bulb-tuber*, or a *corm*), like that of the crocus; the *tunicated*, or coated bulb, like that of the hyacinth or the onion; and the *scaly* bulb, like that of the lily. All these often produce their flowers, without being planted in the ground, and sometimes even without moisture; though in this latter case the flowers are pale and imperfect, and the bulb becomes so exhausted by the effort, that it can seldom be recovered. New bulbs of crocuses and other similar kinds form every year above the old bulb, which gradually wastes away, till only the outer skin is left, which forms a kind of ring round the base of the new bulb, just above the crown or part which throws out the fibrous roots. This may be seen by taking up a crocus soon after it has done flowering, when the new bulb will be found half formed, and the old one half wasted away; and taking up another after the leaves have quite withered, when the new bulb will be found entire, and nothing will be to be seen of the old bulb but the remains of the outer skin.

The main roots of large trees become encased in woody fibre, hardened on the outside till it looks like bark; and these spread widely, so as to serve as a base to support the spreading branches of the tree, but they are always furnished with slender fibrous roots ending in spongioles, the sole use of which is to suck the moisture out of the ground.

THE STEM.

The *stem* of a plant is the upright part which rises from the root, and supports the branches laden with leaves, flowers, and fruit; and stems are of two kinds—namely, they are *ligneous*, or woody, when they belong to trees or shrubs, and last many years; or they are *herbaceous* when they are soft and full of moisture, and die down to the ground every winter.

The stems of trees are called *trunks*, and they are composed of *pith*, *wood*, and *bark*, the wood becoming more solid every year, and the pith, which is in the centre, less. Young shoots and small branches are composed only of pith and bark, as are the stems of small shrubs: but the stems and branches of all ligneous plants become woody as the plants grow older.

The stems of herbaceous plants are generally solid and brittle when they are young; but they become hollow and tough when they get old. Flower stems are called *scapes* when they rise from the root, and *peduncles* when they grow from a branch or main stem. Leaf stems are called *petioles.*

The stems of herbaceous plants are sometimes round, when they are called *terete;* and sometimes square, when they are called *quadrangular;* but the stems and branches of trees and shrubs are always round or nearly so, and never square except when young.

THE LEAVES.

The leaves are as essential to the nourishment of a plant as the roots; for though the roots absorb the moisture which is to serve them as food, yet this moisture cannot increase the size and strength of the plant till it is turned into sap, and this can only be done in the leaves. The leaves are furnished with a number of small pores called *stomata,* which serve as *breathing places* to the plant, and permit the air to act through them on the moisture sent up to the leaves from the roots;

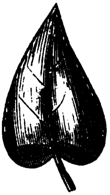
and it is from the change that takes place in this liquid food from its being exposed to the action of the air, and its thin watery part evaporated through the stomata, that it is turned into a thick sugary juice called *sap*. The sap, when thus perfected, descends through the plant; some of it being deposited in every part as it passes along, till at last very little is left to reach the points of the roots. It is this deposition of sap which swells out the plant, giving strength and vigour to every part, and which makes it produce new leaves, and flowers, and fruit.

Leaves consist of two outer skins, which are termed the *cuticle*, a fleshy substance between them which is termed the *parenchyma*, and which is intersected by the *veins*, or *nerves*, as they are called by some botanists. The central vein is larger and stronger than the rest, and this is called the *mid-rib*, and when there are strong side veins branching out from this, the leaf is said to be *feather-nerved*. The veins in some plants are in straight parallel lines, and in others they are curiously intersected like net-work, when they are called *reticulated*. When the veins of two plants are arranged in different ways, the plants are said to differ in their *venation*. The *stomata*, or breathing pores are in the cuticle of the leaf; and in the *parenchyma* are sometimes cells or glands filled with aromatic oil, as in the myrtle, which when the leaf is held up to the light, look like transparent dots. When the cuticle of the leaf is broken by rubbing it between the fingers, the fragrant oil escapes from the cells, and smells much stronger.

The surface of leaves is sometimes *glabrous*, that is quite smooth; and sometimes it is covered with down or hair. When leaves are slightly covered with down, they are said to be *pubescent*, if more so, they are called woolly or *tomentose*, and if the down should be white they are called *canescent*. When leaves are covered with short erect hairs, they are said to be *pilose*, and the hairs are called *pili;* when leaves are covered with long hairs, they are called *villous*, and the hairs *villi;* and when the hairs are very long, shining, and white, and pressed close to the surface of the leaf, they are said to be *silky*. *Bristles* are short, stiff, rigid hairs; and *stings* are stiff, hollow hairs, which give out an acrid juice when touched.

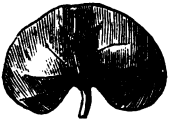
Leaves are of various kinds; but they may be all divided into simple and compound. Simple leaves are those that grow singly, and in one piece; but compound leaves are composed of several small leaves or leaflets.

Simple leaves are of so many different shapes, that Linnæus enumerates more than a hundred named kinds; but as most of these are very seldom met with, it will only be necessary here to mention the more common forms, which are the following :—



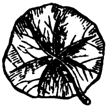
Cordate Leaf.
(1)

The cordate or heart-shaped leaf (fig. 1); the *obcordate* is when the leaf is reversed, and the stalk is fixed in what appears the point of the cordate leaf.



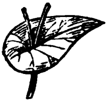
Reniform Leaf.
(2)

The reniform or kidney-shaped leaf (fig. 2). This form is not nearly so common as the cordate leaf.



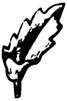
Peltate Leaf.
(3)

The peltate leaf (fig. 3), is where the shape of the leaf is nearly round with the stalk in the centre, as in the garden nasturtium. Many water plants have leaves of this kind.

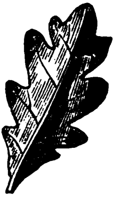


Perfoliate Leaf.
(4)

The perfoliate leaf (fig. 4), is like that of the common honeysuckle, in which the stem appears to pass through the middle of the leaf, and which differs in this respect from the stem-clasping leaf (fig. 5), in which the lower part of the leaf appears to be wrapped round the stem. This latter kind of leaf is also called *amplexicaulis*.

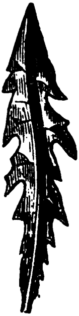


Stem-clasping.
(5)

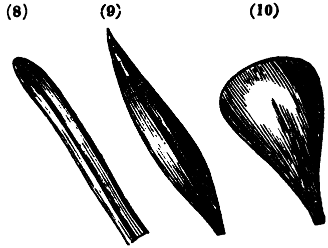


Sinuated Leaf
(6)

The *sinuated* leaf, like that of the oak (fig. 6), is deeply cut, with the *lobes* pointing upwards; and in this respect it differs from the *runcinate* leaf (fig. 7), like that of the dandelion, the lobes of which all point downwards towards the stalk.



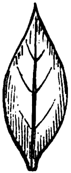
Runcinate Leaf.
(7)



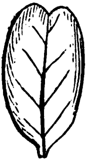
Linear, Lanceolate, and Cuneiform Leaves.

Linear leaves are long and narrow with a blunt point, as shown in fig. 8; *lanceolate* leaves terminate in a sharp point, as shown in fig. 9; and *cuneiform*, or wedge-shaped leaves (fig. 10) are much broader at the point than at the stalk.

Besides these, there are oval leaves, oblong leaves, arrow-shaped leaves, and many other kinds, the shapes of which will be easily understood by their names.

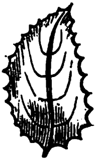


Acuminate.
(11)

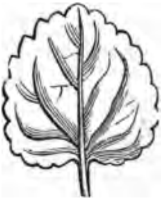


Emarginate.
(12)

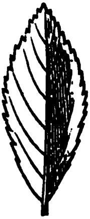
The extremities of leaves are distinguished by several different names. Sometimes the end of the leaf appears as though abruptly cut off, as in the tulip tree, and these leaves are called *truncate;* and sometimes the leaf terminates in a point as shown in fig. 11, when it is said to be *acuminate.* When this point is hard and sharp, the tip is called a *mucro*, and the leaf is said to be *mucronate.* Sometimes the extremity of the leaf looks as though the point had been gnawed or bitten off, when the leaf is said to be *eroded;* and sometimes it looks as though it had a notch or slit in the middle, as shown in fig. 12, when it is said to be *emarginate.* Besides these terminations, the points of leaves are sometimes elongated into tendrils, and sometimes into singular, curiously-shaped appendages as in the Chinese pitcher plant, Nepenthes distillatoria; and sometimes the petiole is dilated so as to resemble a leaf, as in some kinds of acacia.



Dentate Leaf.
(13)

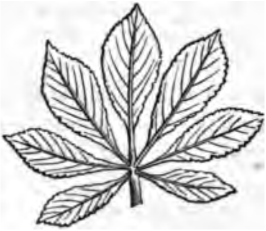


Crenated Leaf.
(14)



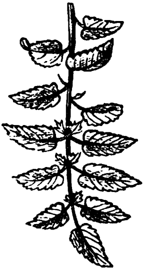
Serrated.
(15)

The margins of leaves also differ very much: sometimes they are *dentated*, or toothed, as shown in fig. 13; and sometmes *crenated* or scalloped, as shewn in fig. 14. Sometimes the margins are quite smooth, and sometimes they are *serrated* like the teeth of a fine saw, as shown in fig. 15. The *ciliated* leaf has a smooth margin, edged with fine hairs like an eyelash; and the *undulated* or wavy leaf has the margin undulated like a flounce. The *crisped* leaf is only excessively undulated.

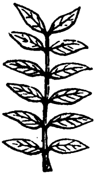


Palmate Leaf.
(16)

The most common kinds of *compound* leaves are those called the *palmate*, and those called *pinnate*. The palmate leaves have *three*, *five*, or *seven leaflets*, springing from one point at the extremity of the petiole or leaf-stalk, as shown in the leaf of the common horse chestnut (fig. 16). The pinnate leaves have *five* or *seven* or more pairs of *leaflets* ranged on



Impari-pinnate Leaf with Stipules.
(17)



Abruptly Pinnate Leaf.
(18)

each side of a common stalk; and there are many different kinds, as for example the *impari-pinnate,* which is when the compound leaf ends in an odd leaflet, as shown in fig. 17, and the *abruptly pinnate,* which is shown in fig. 18. The leaflets in pinnate leaves, which are alled *pinnæ,* are generally in pairs exactly opposite to each other, as shown in fig. 18; but sometimes they are irregularly placed towards the base, as shown in fig. 17. Sometimes the leaves are *decompound,* that is twice branched, as in the leaves of many of the kinds of mimosa; and sometimes they are *supra-decompound,* as in those of the carrot. *Bipinnate* leaves are where the leaflets of a pinnate leaf are themselves pinnate, as in the leaves of the *acacia julibrissin,* and the common fumitory.

Leaves are sometimes so deeply cut into lobes as to appear pinnate, though they are not divided into separate leaflets, as for example, the leaves of some of the kinds of ferns; and these are called *pinnatifid.* Leaves are also frequently divided by very deep incisions; and when these are regular the leaves are said to be *cut,* and when irregular they are said to be *lacerated* or torn. When the incisions are very deep, and the segments of the leaf are sharply pointed, the leaf is said to be *laciniated*.

The position of leaves varies very much, and is always mentioned in describing a plant; as for example whether the leaves are in pairs opposite to each other when they are said to be *opposite*; or placed singly, first on one side the stem and then on the other, when they are said to be *alternate*. When they grow like a wheel round a joint in the stem, they are said to be *verticillate* or *whorled*; and when they lie over one another like scales, they are called *imbricated*. Leaves are sometimes attached to the stem or branches by short stalks called *petioles*, when they are said to be stalked; and when they grow on the stem or branches without any stalks, they are said to be *sessile*. The leaves that grow on the stems of herbaceous plants are called *cauline*; and those that spring from the root are the *radical* leaves. Floral leaves or *bracteæ*, are those which are produced on the flower stem immediately below the flower; when several of these are joined together, they form what is called an *involucre*. The covering of the filbert is an involucre.

Stipules are small leaves growing at the base of the petiole of the true leaf, or at the base of each leaflet of a pinnate leaf, as shown in fig. 17 in page 14. *Tendrils* are elongations of the points of the leaves, when the leaves are said to be *scirrhous;* or slender leaf-like bodies proceeding from the stem, which are the proper tendrils, like those of the vine.

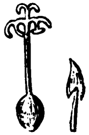
When the petiole of a leaf can be easily detached from the stem, it is said to be *articulated*, or jointed; when leaves fall at the approach of winter, they are said to be *deciduous;* and when they remain on, after they have withered, like those of the birch and the horn-beam, they are called *persistent.*

Prickles are metamorphosed leaves, and as they are what is called *articulated,* they may be easily detached without tearing the bark or injuring the branch; as may be seen with the prickles of the rose tree, which may be removed by slightly pulling them with the thumb and finger. This is not the case with *thorns,* which contain wood, and cannot be detached without tearing the bark. According to botanists, thorns are abortive branches, and they may often be seen in an imperfect state, as those of Gleditschia horrida, which grow from the trunk of the tree, and those of the barberry, which spring from the axils of the leaves. *Spines* are the thorns of herbaceous plants; they do not contain wood, but they cannot be detached without injuring the stem or leaves on which they grow: as for example, the spines on the spiny acanthus.

Leaf-buds vary very much in different plants, not only in their outward appearance, but in the manner in which the young leaves are folded up in them. The manner in which the leaves are folded in the bud is called their *vernation*, or *foliation*; sometimes the vernation is said to be *involute*, and this is when the young leaves form two rolls both bending inwards, as in the bud of the apple tree. *Revolute* signifies when the young leaves form two rolls bending outwards, as in the bud of the rosemary; and *convolute* is when the leaves are rolled up in each other. The shape of the buds also differs considerably: in some plants they are long and slender and quite dry, as in the spindle tree; and in others short and abruptly pointed, and covered with a kind of gum, as in the horse-chestnut.

THE FLOWER.

The flower is the most important part of every plant, because it contains within it the organs necessary for producing the seed. These organs are the *pistils* and the *stamens* (fig. 19); and to protect them, nature has provided a covering called a *calyx*, and sometimes two coverings called the *calyx* and the *corolla*, the two together forming what is called the *perianth* of the flower.

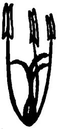


Pistil and Stamen.
(19)

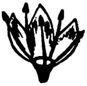
The *pistil* consists of a globular or egg-shaped point at the base, which is called the *ovary*, or *germ*, and which afterwards becomes the seed-vessel; and to this is joined a long tube called the *style*, which spreads out at its summit into a fleshy substance called the *stigma*. In the ovary are one or more little substances called *ovulæ*, which afterwards become seeds. The ovary, which when ripe becomes the *carpel*, is generally divided into two or more cells, separated by membraneous partitions, which are called *dissepiments*. Sometimes there is no style, and the stigma grows close to the ovary, and when this is the case, the stigma is said to be *sessile*.

The *stamens* generally consist of long or short thread-like stalks called *filaments*, each bearing what is called an *anther*. The anther consists of one or more cells filled with a light dust or powder called *pollen*, which is generally yellow, as in the lily and in the rose, but sometimes black, as in the poppy. When the pollen is ripe, the cells of the anthers burst, and appear covered with a fine powder, which sticks to whatever may touch it. About the same time that the anther bursts, the stigma becomes covered with a glutinous moisture, which absorbs the pollen that falls upon it and conveys it down the style to the ovary, where its presence is necessary to perfect the young seeds, as without the pollen they would be abortive. Sometimes there are no filaments, and the anthers grow erect from the centre of the flower, in which case they are said to be *sessile*.

When the anthers are attached to the filament by the back, or part opposite to that which is grooved, they are said to be *adnate;* and this is their most common form, as may be seen by examining the anthers of the rose and many other plants. When the anthers are attached by their base, as is shewn in fig. 19, in page 17, they are called *innate;* and when the anthers are so slightly attached in the centre as to quiver with every breath, they are called *versatile*.

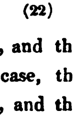


Hypogy-
nous
Stamens.
(20)



Perigynous
Stamens
growing out
of the Calyx.
(21)

When the stamens grow from under the ovary, as shewn in fig. 20, they are called *hypogynous;* and in this figure the ovary is shewn with a sessile stigma, that is, there is no style. When the stamens grow out of the ovary, they are called *epigynous;* and when they grow to the calyx, as shewn in fig. 21, or to the corolla, as shewn in fig. 22, they are said to be *perigynous*—this last word being used in all cases where the stamens grow apart from the ovary.



Perigynous
Stamens
attached to
the Corolla
(22)

Sometimes the stamens are in one flower, and the pistils in another; and when this is the case, the stamen-bearing flowers are called the males, and the pistil-bearing flowers the females, and the latter only produce seed. When flowers of both kinds are on one plant, the plant is called *monœcious;* and when they are on different plants, the plants are said to be *diœcious.*

The *calyx* and the *corolla.*—Where there is only one covering to the stamens and pistil, it is called the *calyx;* but when there are two coverings, the outer one is called the *calyx,* and the inner one the *corolla.*

Generally the calyx is green when there is a corolla; but when there is none, it is coloured, as is the case with the clematis, what we call the flower being only a coloured calyx. The divisions of the calyx are called *sepals;* and those of the corolla are called *petals.* Sometimes the calyx and the corolla are both coloured and so mixed together as not to be easily distinguished, as in the iris and many kinds of bulbous plants; and when this is the case, the divisions are called the *segments* of the *perianth.* Sometimes the stamens and pistils are without any covering, in which case the flowers are said to be *apetalous.*

When the calyx and the corolla grow above the ovary, it is said to be *inferior;* and when they grow from below it, the ovary is said to be *superior.* Sometimes the flowers fall before the fruit begins to swell, and then they are called *caducous* or fugitive, as in the poppy; but when the ovary is inferior, and the calyx remains on till the fruit is ripe, it is called *persistent.*

The apple is an example of an inferior ovary with a persistent calyx; what is called the eye of the apple, being the persistent calyx, and the fruit itself the ovary.

The *corolla* is either formed of one petal, when it is said to be *monopetalous*, or of several, in which case it is said to be *polypetalous*. The *monopetalous* corolla consists of three parts: the *tube*, or *cylindrical* part; the *mouth*, or *throat*, which is sometimes also called the *faux;* and the *limb*, or *spreading* part. There are many kinds of monopetalous corollas, but the principal are the following:—

The *campanulate*, or bell-shaped, like the Canterbury bell; the *infundibuliform*, or funnel-shaped, as in the convolvulus; the *hypocratiform*, or salver-shaped, as in the primrose; the *rotate*, or wheel-shaped, as in the jasmine; the *urceolate*, or pitcher-shaped, as in the Cape heaths; the *ringent*, *gaping*, or *labiate*, as in the flowers of the common sage; the *masked*, or *personate*, as in the snap-dragon; the *spurred*, or *calcarate*, as in the larkspur.

The polypetalous corolla has also many shapes; and its petals are in many cases divided into two parts, one long and narrow, which is generally partly hidden by the calyx, and which is called the *unguis*, or claw, and the other a spreading part, which is called the *lamina*, or limb. In orchideous, and some other plants, the limb is sometimes lengthened and curved upwards, when it is called the *labellum*, or little lip.

The most remarkable of the polypetalous corollas, are the *cruciform*, so called because they consist of four petals, arranged so as to form a Greek cross, and the *papilionaceous*, or pea-flowers. In these last, the large upright petal is called the *vexillum*, or standard; the two small side ones the *alæ*, or wings; and the two lower petals which appear joined together, the *carina*, or keel.

The *nectary* is a petal-like appendage to the flower, generally curiously folded up, which has received its name from its being formerly supposed to be a receptacle for honey.

The *flower-buds* are interesting, from the different manner in which the petals of different flowers are folded in them, and this is called their *æstivation*. In some cases: as for example, in the poppy, they are *wrinkled*, or *crumpled up;* and in others, as in the convolvulus, they are *twisted*, or *convolute*.

The *inflorescence*, or position of the flowers with regard to each other, is another point noticed by botanists. Flowers are either *terminal*, that is, they grow at the extremity of the shoots; or *lateral*, that is they spring from the sides of the branches. They are also produced either *singly*, or in *clusters*, and these clusters are generally of one of the following kinds:—

A *spike,* which is when the flowers grow round a long upright stalk, without having small separate stalks to each flower, as in the common veronica, or speedwell, and in most grasses. See fig. 23.

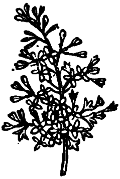
A Spike.
(23)

A *catkin* is a pendant spike, the flowers of which have neither calyx nor corolla; as the catkin of the hazel, the birch, or the willow. See fig. 24.

A Catkin.
(24)

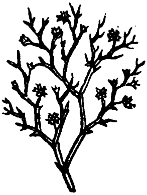
A *raceme* is either an upright or a drooping spike, the flowers of which have separate small stalks to each: as for example, the flowers of the common currant, the laburnum, or the rose acacia. See fig. 25.

A Raceme.
(25)



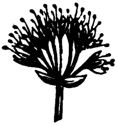
A Thyrse.
(26)

A *thyrse* is a close, upright, branched raceme, like that of the lilac. See fig. 26.



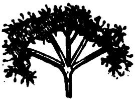
A Panicle.
(27)

A *panicle* is a loose raceme, with branched stalks to the separate flowers, like a panicle of oats, or a tuft of sea lavender. See fig. 27.



An Umbel.
(28)

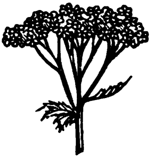
An *umbel* is where the flowers have separate stalks springing from a common centre, but of unequal length, so as to form a head level at top, as in the common parsley. Sometimes the *umbel* is not quite level at the top, as in fig. 28.



A Cyme.
(29)

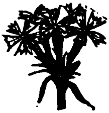
A *cyme* is an umbel with branched stalks, which make the bunches of flowers round instead of flat at the top, as in the elder. See fig. 29.

A *corymb* is a cluster of flowers, nearly level at top, but growing on stalks of different lengths from different parts of the main stem, and not from a common centre, as in the common milfoil. See fig. 30.



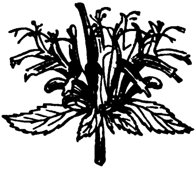
A Corymb.
(30)

A *fascicle* is a close corymb, with the flowers on short stalks, so as to form a little bundle, as in Lobel's catchfly. See fig 31.



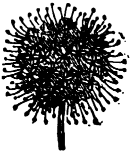
A Fascicle.
(31)

A *whorl* is where the flowers grow round a joint in the main stem of the plant, as in the dead nettle. See fig. 32.



A Whorl.
(32)

A *head* is when a number of small flowers grow so close together on a common receptacle as to seem but one flower, as the daisy, or the globe amaranth. See fig. 33.



A Head of Flowers.
(33)

In addition to these, may be mentioned a *spadix*, in which the flower is sheathed in a large leaf called a *spathe*, as in the arum, and in the calla, or Richardia Ethiopica.

THE FRUIT AND SEED.

The *fruit*.—In the language of botanists every seed vessel is called a fruit, though it is sometimes dry and membraneous, and sometimes covered with a fleshy or pulpy substance. The principal kinds of fruits, are the *legume*, or pod, like those of the pea and bean, and allied to which, are the *silique*, or *silicle*, which contain the seeds of cruciferous plants; the *nut*, like that of the hazel; the *drupe*, or stone fruit, as the peach or plum; the *pome*, or kerneled fruit, as the apple or pear; the berry, or *baccate* fruit, as the currant; the *acorn;* the *capsule*, like that of the peony; the *samara*, or key, like that of the maple; and the *achenium*, or dry fruit, like that of the sunflower, the achenium having very frequently a feathery wing attached to it called the pappus.

An example of the achenium, with its pappus attached, may be seen in the seed of the dandelion, or in that of the thistle; and the use of these feathery wings is to carry the seed to a distance, and thus to scatter it, instead of letting it all fall in one place, where it would be too crowded.

Seed-vessels, if when ripe they open naturally to let out the seed, are said to be *dehiscent;* and *indehiscent* when they do not open in this manner. The pod of a pea is *dehiscent*, and the parts into which it splits are called *valves;* while the part to which the peas are attached, is the *placenta.* Most seeds have a placenta to which they are attached, but in some cases it grows in the middle of the ovary without adhering to the sides, where it is said to be *free central;* and at others it grows from the sides, and is open in the middle, when it is called *parietal.* When capsules are divided into several cells, the membrane which divides them is called the *dissepiment;* and when the cells separate from each other to discharge the seed, the dehiscence is said to be *septicidal;* but when they remain together and only open at the *dorsal suture*, in the middle of the back of each cell, the dehiscence is *loculicidal. Carpels* have two natural places for opening, which are called the *dorsal* and *ventral sutures;* and both these may be seen in the pod of the pea, the *ventral* suture being that to which the placenta with the peas is attached. The covering of the seed when not membraneous, is called the *pericarp;* and this in stone fruit is divided into three parts —namely, the skin or *epicarp*, which may be easily peeled off, the fleshy eatable part called the *sarcocarp*, and the hard covering of the kernel or stone, which botanists call the *putamen*, or *endocarp*. The real seed is the kernel contained within the stone. Most of the kerneled fruits are indehiscent, and if left to nature must decay before they can liberate the seed. The gooseberry and the currant are true berries, that is, when ripe, their seeds lie buried in a mass of pulp; but the raspberry, the strawberry, and the mulberry are not true berries—the raspberry and mulberry being a collection of fleshy drupes with a stone in each, on a dry receptacle, and the strawberry bearing its seeds on the outside of a fleshy and eatable receptacle.

Seeds when perfect contain the embryo of the future plant: sometimes the entire seed is occupied with this embryo, as in the bean; but in others the embryo is found folded up in many different forms, and buried in a mass of feculent matter, called the *albumen*. Every embryo consists of three parts: the *radicle*, or root, the *plumule*, or germ of the future plant, and the *cotyledons*, or seed leaves, which fall off soon after the true leaves begin to expand. Some plants have two cotyledons, or seed leaves, and are called *dicotyledonous;* others have only one, when they are called *monocotyledonous;* and this difference constitutes the distinguishing mark between the two great classes of flowering plants, according to the Natural System. The plants which bear no flowers, such as the mosses and ferns, have no cotyledons; and are called *acotyledonous*.

The seed is covered with a *testa*, or skin, on which is a little mark called the *hilum*, or eye, which shews where the seed has been attached to the placenta. In some plants the hilum is very visible, and the American horse-chestnut (Pavia) is called buck-eye by the inhabitants, from the hilum of the fruit having the appearance of a stag's eye. Sometimes there is a kind of cord along the seed called the *raphe*, which reaches from the hilum to a point at the other extremity of the seed called the *chalaza;* and this may be plainly seen in the seed of a lemon.

Sometimes the seed is attached to the placenta by a short stalk called a *funicle*, like the pea; and in other cases it hangs even when it is ripe by a long string called an umbilical cord, like the seed of the magnolia, or by a kind of loose skin called an *arillus*, like the seed of the spindle tree.

The ferns, mosses, fungi, etc. have neither flowers nor seed, properly so called; but in lieu of the latter, they are furnished with minute granular bodies called *spores*, or *sporules*, which when sown become distinct plants. These sporules differ from seeds, in not requiring to be fertilized by pollen, and also in their construction; and they are produced in little cases called *thecæ*, which in the ferns appear on the back of the leaf, and burst when ripe. In the mosses, the thecæ are produced on long stems, and are covered with a kind of cap called a *calyptra*, which detaches itself and drops off when the sporules are ripe. The mushrooms and other kinds of fungi have their thecæ and sporules among the *laminæ*, or gills as they are called, below the cap; and the lichens and sea-weeds have theirs curiously protected, and admirably adapted to the situations in which they are produced, and in which they are to grow. In short, the meanest objects in the vegetable kingdom have been as wonderfully contrived, and shew as evidently the Divine wisdom by which they have been organised and fitted for the stations they are to fill, as the noblest forest tree; and the more we study to unfold the secrets of Nature, the more we shall feel impressed with awe and admiration of that beneficent Being, who has made all these wonders, and given them to us for our use.

CHAPTER II.

OF THE NATURAL DIVISIONS OF PLANTS.

PLANTS are naturally divided into *ligneous* and *herbaceous*, *evergreen* and *deciduous*, and *flowering* and *not flowering;* and these grand divisions are sub-divided into many smaller ones.

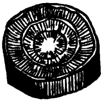
LIGNEOUS PLANTS.

All plants that have hard woody stems are called *ligneous;* and these plants last several years, producing flowers and fruit every season after they have attained the age of maturity.

All ligneous plants must be either trees or shrubs.

TREES.

Trees have one upright stem or trunk, rising from the root, and growing to a considerable height before it divides into branches, and they are of three kinds: namely, dicotyledonous, monocotyledonous, and acotyledonous. The trunk and branches of *dicotyledonous* trees, are composed of *pith*, *wood*, and *bark*. At first, the substance within the bark is little more than pith; but as every year the sap deposits a layer of wood between this substance and the bark, which presses against the previous layers so as to contract them, these press also against the pith, which becomes smaller every year, till at last in old trees it is scarcely perceptible. These layers of wood are always perfectly distinct from each other; and as only one is deposited every year, when a tree is cut down, its age may be counted from them, as may be seen in fig. 34, which shews a young oak of three years old, with a large proportion of pith in the centre. When trees grow rapidly, the layers of wood are broad, and of comparatively coarse texture; but when trees grow slowly, the layers of wood are narrow, and the wood is very hard.


Wood of a young Oak.
(34)

As the bark of the young tree would be too tight for the tree when the size is increased by the annual deposition of fresh wood within it, it is gifted with a power of extending itself considerably, and a deposition of new bark called *liber* takes place also every year within the old bark, so that when the old bark can bear no farther distension, but cracks and peels off, there is a new bark within to supply its place. It is the liber of the lime tree which is manufactured into what we call bast mats. These mats are made principally in Sweden and Russia, on the shores of the Baltic; and as the bark of trees is in these countries called bast, the mats hence derive their name. The word is sometimes written and pronounced bass, but this is only a corruption of the true name.

The new wood of the tree which is deposited every year, is called *alburnum*, or sap wood, and it may be easily distinguished from the hard wood, when the tree is cut down, by its lighter colour and porous texture. As soon as a new layer of alburnum is deposited, the alburnum of the previous year changes its colour and becomes harder, and the layers within that harden in proportion; thus as the wood continues every year to grow harder and harder, the pith disappears, and the wood near the centre of the tree which is the oldest, becomes the best; and hence the excellence of what is termed "heart of oak," in old oak trees.

Besides the layers, the wood of *dicotyledonous* trees is marked with slender divergent lines, proceeding from the centre to the bark, as may be seen in fig. 34; these lines are called by botanists *medullary* rays, and they produce the wavy lines or veins observable in worked timber. The knots are where there have been branches.

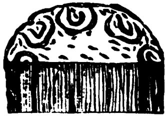
The stems of trees are called *trunks* up to the place where they divide into branches, and form what is called a head. The largest and thickest branches are called *limbs*, and the smaller ones *boughs*, *twigs*, or *spray*. The annual growth of every season is called the *young shoots* of the current year. When the head of a tree is cut off, it is called the *lop*, and the old trunk which is left to send up young shoots, is called a *pollard*.

The roots of trees being intended to support a heavy branching head, are very large and strong, and are generally spread over a considerable extent of ground to afford a sufficient base to support the tree. Those of the oak descend deeply into the ground, while those of the elm and several other trees spread near the surface; and hence these trees are more easily blown down by high winds than oaks are.

Monocotyledonous trees are only found within the tropics. Their wood is more fibrous than solid, and when cut down it seems full of pores; its nature may be seen by cutting across a rattan cane, or by examining the wood of a palm tree—see fig. 35. These trees have neither annual layers of alburnum nor medullary rays; and their trunks increase very little in thickness during the whole period of their growth, the newly-formed fibrous matter which is

The wood of a Palm tree.
(35)

deposited in their centre every year, only rendering them somewhat more solid. These trees have never any branches, like those of the trees of Europe.



The wood of a tree-fern.

(36)

The only ligneous plants belonging to the *acotyledons* are the tree ferns (see fig. 36), the wood of which appears in zig-zag lines when cut across, and which has been supposed to consist of a bundle of petioles growing together after the decay of the leaves to which they belonged. Very little, however, is as yet known respecting these plants.

SHRUBS.

Shrubs differ from trees in being much smaller in size, and in generally having several stems of nearly the same thickness, instead of one large trunk rising to a considerable height without a branch, and then forming a large head. Shrubs are of many kinds, the principal of which are *bushes*, *trailers*, *creepers*, *climbers*, and *twiners*.

Bushes are large upright shrubs, generally growing several feet high, and either consisting of numerous small stems rising from the ground of nearly equal thickness, like the common lilac; or of more compact roundish bushes, rising from the ground with several stems, like the gooseberry.

Trailing shrubs lie on the surface of the ground, spreading over it to a considerable extent, but without rooting into it, like the common periwinkle; these shrubs may be trained up a tree or wall, but they require tying or nailing.

Creeping shrubs are those that lie on the surface of the ground, and root into it at every joint; as for example the ivy. These plants will creep up a tree, or against a wall, without any fastening but what is afforded by their own roots, which will attach themselves to the bark of the tree, and penetrate into the crevices of the wall.

Climbing shrubs have long slender tendrils, by which they attach themselves to any object that may be near them, twisting their tendrils backwards and forwards in a most extraordinary manner, so as to take a firm hold. The cobœa is an example of a well-known plant of this kind; and it will twist its tendrils so firmly round any other plant that may be near it, as frequently to kill the branch it has attached itself to.

Twining shrubs are without tendrils, and they support themselves by twining round any object that may be near them. Familiar examples of twining plants, are the honeysuckle and the convolvulus; the latter, though herbaceous, being here mentioned as a familiar example of the different manner in which these plants twine themselves round the objects that are to support them, the convolvulus always growing from the right to the left, and the honeysuckle from the left to the right. Sometimes twining shrubs support themselves.

HERBACEOUS PLANTS.

This division includes all plants that have not woody stems; and they are of three kinds:—

Perennials are plants that live several years, bearing flowers and fruit every year, and when they die down to the root in winter, send up fresh shoots in spring. Some herbaceous perennials do not die down to the ground in winter, but retain green leaves all the year, for example, the pink and carnation.

Biennials are plants that live two years, requiring to be sown in spring, and not flowering till the second summer. Sometimes these plants will live three or four years, as for example the wall-flower and the hollyhock.

Annuals are plants that live only a single summer, requiring to be sown every spring, and dying when they have ripened their seed; as for example, the sweet pea. To these may be added *Suffruticose plants*, which are those the stems of which are half woody and half herbaceous; and which do not die down to the ground in winter. The tree-peony is a suffruticose plant.

EVERGREENS.

Evergreen plants are those that do not lose their leaves in winter, and which, though they change their leaves every year, yet from only losing a few at a time, are never left entirely bare. The principal evergreen large trees grown in England belong to the pine and fir tribe, including the cedar and the yew. The pines and firs, and cedars, are what are called the needle-leaved trees; and these trees when once cut down, never send up shoots from the root; they also never send up any suckers. They abound in turpentine, from which is made pitch and tar, and their fruits are called cones. The larch, though belonging to the pine and fir tribe, is not an evergreen, as it loses its leaves every winter.

The holly is the principal evergreen small tree in British gardens, and the laurel and the laurestinus are the principal shrubs. All evergreens are particularly well suited to the moist climate of England, and still more so to that of Ireland, by which they are kept growing all the year; but they seldom thrive on the continent, where the summers are much warmer, and the winters much colder.

DECIDUOUS TREES.

These plants lose their leaves every autumn, and send out fresh ones every spring; and thus as they have a season of complete repose during winter, they succeed in a climate that is very hot in summer and very cold in winter, better than in one in which the climate is more nearly equal all the year. Deciduous trees differ also from evergreen ones in throwing out fresh shoots from the roots when they are cut down, and in frequently throwing up suckers, which evergreen trees never do. They are also generally propagated by layers and cuttings, while evergreens are almost always increased by seeds or grafting. All ligneous plants that send up fresh shoots from the collar of the root when they are cut down, are said to *stole*.

SUCCULENT PLANTS.

Succulent plants partake of the nature of evergreens, in not undergoing any change when they are in a healthy condition during winter; but they differ from all other plants in the brittle and juicy substance of their stems, and in the little distinction that has been made by nature between their stems and leaves. They also differ from other plants in having scarcely any stomata or breathing pores, one of the uses of which, it may be remembered (see p. 7), is to carry off the superfluous moisture; and hence succulent plants are admirably adapted for the burning sands which form their native countries; their want of stomata rendering them exactly fitted for a hot dry atmosphere, in which the evaporation from leaves abundantly furnished with stomata would be so great as to render constant watering necessary to enable the plants to endure it. It is for this reason that succulent plants are so easily killed in England; for if too much water be given to them, the leaves have no means of throwing it off, and they become rotten; or as gardeners term it, they damp off.

There are many kinds of succulent plants, but the most important are the *mesembryanthemums*, or *fig-marigolds*, and the *cacti*. The ice-plants, which are two species of mesembryanthemum, are remarkable for the glistening papulæ or blisters that form under the cuticle, and which, being full of a half-transparent substance, make the plant look as though it were covered with ice. The cacti are still more remarkable: the tallest kinds of cereus or torch-thistle, grow in their native country (Brazil) to the height of thirty or forty feet, without a single branch or even leaf, and with a fleshy angular stem, covered with spines. The opuntias or Indian figs appear, on the contrary, to have no stems, but only a succession of flat succulent leaves joined together; it is on one of these plants that the cochineal insect is found. Other kinds of the cacti are nearly globular; and others have a kind of cap on their summit, which resembles a great muff. They have all brilliant flowers, and they are all armed with fearful spines. Their great use, however, in their native country, is to serve as reservoirs of moisture for men and animals, who can suck the juice from their fleshy stems in places where no other kind of liquid can be procured.

PARASITES AND EPIPHYTES.

Parasites are plants that live upon other plants, and not upon the ground; sending their roots down into the soft wood, and drawing their nourishment from the tree to which they cling for support. The mistletoe and the dodder are two of the best known parasitic plants in Britain. The first of these (the mistletoe) grows at once on the branch of a tree, from its fruit being crushed by birds, or the seed dropped accidentally against some part of a branch, where a fissure in the bark enables it to insinuate its roots. The dodder on the contrary, springs from the ground: though, when it has taken firm hold of some unfortunate plant, its root withers, and it feeds entirely on the sap of the plant to which it has clung. Both parasites are injurious, but the dodder is decidedly the most so.

Epiphytes differ from parasites in not deriving any support from the trees on which they grow. Epiphytes are, properly speaking, air plants; and contrary to the habit of terrestrial plants, their roots do not bury themselves in the soil, but they hang down in the air. They are found in their native countries (the tropical part of South America, Mexico, and the East Indies) in close damp woods, growing on the branches of trees, with their rich and fantastic flowers hanging down as a sort of natural drapery. In England, these plants can only be grown in great heat and a very moist atmosphere; and instead of being planted in pots, they are generally tied with a little moss to portions of the branches of trees with their bark on, which are hung up by pieces of string or wire to the roof of a hothouse. All these plants belong to the natural order, Orchidaceæ.

HARDY, HALF-HARDY, AND TENDER PLANTS.

Hardy plants, in British gardens, are those that will bear the climate of England without any protection during winter. *Half-hardy* plants are those which require protection during winter, but which may be grown in the open ground during summer; and *tender* plants are those which require to be kept in plant-houses all the year.

CHAPTER III.

OF THE BOTANICAL DIVISIONS OF PLANTS.

USE OF CLASSIFICATION.

From the earliest times, in which we have any record of the study of plants, botanists appear to have felt the want of some mode of throwing them into groups so as to aid the memory in retaining their names. Thus it is easier to remember the general name of rose for all roses, than it would be to remember these flowers if all the twelve hundred species and varieties of roses now grown in gardens, had names not bearing the slightest resemblance to each other. We now, for example, when we hear that a plant is a rose, have a general idea of its nature and habits without knowing what kind of rose it may be; but if all roses had quite distinct names: as for example, if one were called polyhymnia vulgaris, and another nepeltrodia communis, etc., it would be necessary to know all these names and all the flowers distinguished by them, before the name of any plant could convey the slightest idea to the mind as to what the plant was.

The necessity of classing together those plants which resemble each other being thus evident, the only difficulty which remained was to know what parts of the plant should be compared to discover which plants did most resemble each other; and on this score the most eminent botanists have differed. Some, as for example, Tournefort, chose the flower, and placed all the plants that had cup-shaped flowers in one class, and those that had bell-shaped flowers in another, and so on. Others, as for example Cæsalpinus, took the fruit for the point of comparison, and put all the plants with globe-shaped fruits into one class, those having flat fruits into another, etc.; none of these, however, were much followed, and no general system of classification was adopted till the time of Linnæus, who fixed on the number of the stamens and pistils contained in each flower, as the standard of comparison. This plan soon became popular, as it seemed to enable every one who could count to become a botanist; and it has many followers even at the present day.

The system of Linnæus was, however, very imperfect from the frequent variations that occurred in the number of stamens and pistils, sometimes even in flowers on the same plant, and very frequently in plants that evidently resembled each other in all other respects. To obviate these difficulties Linnæus devised what he called a Natural System, by which those plants should be classed together which resembled each other in most particulars, but unfortunately he died before he could carry his ideas fully into effect. In the meantime, Bernard Jussieu had invented the Natural System which now bears his name, and which has since been very much altered and modified by other botanists.

The system of Linnæus is called an Artificial System, because as it depends entirely on the number of pistils and stamens which a flower contains, plants are thrown together by it, which have no natural analogy, and indeed, no connexion with each other, except in the eyes of a botanist; and the system of Jussieu is called the Natural System, because the plants thrown together by it agree not only in their parts of fructification, but in their general appearance, habits, and properties, and thus seem naturally allied even to those totally unacquainted with botany.

Both Linnæus and Jussieu, and indeed all other botanists, divide plants into classes, orders, genera, species, and varieties; and the only points in which they disagree are, as to the nature and characteristics of their classes and orders.

CLASSES, ORDERS, GENERA, SPECIES, AND VARIETIES.

A *class* consists of a number of plants which resemble each other in some grand leading feature, but differ in minor particulars. The classes according to the Natural System being few, and each containing many plants, have been re-divided into sub-classes, which are afterwards divided into orders; but the Linnæan classes being numerous, and each containing only a few plants, are only re-divided into orders.

An *order* consists of a number of plants that very closely resemble each other in some leading particulars; and according to the Natural System, these points are so numerous that the plants belonging to most may be recognised at first sight: as for example, any of the cruciferæ, umbelliferæ, or leguminosæ. Some of the natural orders that contain a great number of plants are again divided into sub-orders, sections, and tribes; the use of which is to shew what plants are most nearly allied to each other.

A *genus* consists of plants very closely resembling each other, not only in the position and number of the organs of fructification, but in the form and general appearance of the flower, so that even according to the Linnæan system, the plants can be recognised at first sight as belonging to each other. For example, roses differ very much from each other, yet all can be recognised at first sight as belonging to the same genus.

A *species* indicates the plants belonging to a genus which are distinguished by some marked peculiarities of form or construction, so as to be easily recognised: as for example, Rosa centifolia, the cabbage rose, is a species of the genus Rosa.

A *variety* indicates the individuals of a species which differ from each other, in some not very important points, but yet some that can be easily distinguished; such as having double, or semi-double flowers, or the flowers being of a different colour to those of the species. The musk rose is a variety of the cabbage rose, and it is called by botanists Rosa centifolia var. muscosa, or as it is more commonly written R. c. muscosa. Sometimes where there are several varieties, they are indicated by figures, and at other times by the letters of the Greek alphabet; observing that the species is always reckoned for one, and that the varieties accordingly either begin with two, or with β, the Greek letter Beta.

Besides these, there are what are called *hybrids*, which are raised by fecundating the stigma of a plant of one species with the pollen of a plant of another species, or sometimes even of a nearly allied genus; and cross breds, which are raised in the same manner between two varieties of the same species—hybrids being generally described as species, and crossbreds as varieties.

THE LINNÆAN SYSTEM.

Linnæus divided all plants into two great classes, those having visible flowers, which he called *phænogamic*, and those having no visible flowers, which he called *cryptogamic*. The flowering plants he again divided into classes and orders, the classes depending in most cases on the number of the stamens, and the orders on the stigmas or ovaries. He made twenty-four classes, each of which was divided into several orders, and these were again divided into genera, species, and varieties.

TABLE
OF
THE LINNÆAN CLASSES AND ORDERS.

Classes.	Orders.
1. MONANDRIA, one stamen, has two orders.	1. *Monogynia*, with one ovary; and *Digynia*, two ovaries.
2. DIANDRIA, two stamens, has three orders.	2. *Monogynia*, *Digynia*, and *Trigynia*, three ovaries.
3. TRIANDRIA, three stamens, has three orders.	3. *Monogynia*, *Digynia*, and *Trigynia*.

4. TETRANDRIA, four stamens, has three orders.	4. *Monogynia*, *Digynia*, and *Tetragynia*, with four ovaries.
5. PENTANDRIA, five stamens, has six orders.	5 *Monogynia*, *Digynia*, *Trigynia*, *Tetragynia*, *Pentagynia*, with five, ovaries; and *Polygynia*, with many ovaries.
6. HEXANDRIA, six stamens, has four orders,	6. *Monogynia*, *Digynia*, *Trigynia*, and *Polygynia*.
7. HEPTANDRIA, seven stamens, has four orders.	7. *Monogynia*, *Digynia*, *Tetragynia*, and *Heptagynia*, with seven ovaries.
8. OCTANDRIA, eight stamens, has four orders.	8. *Monogynia*, *Digynia*, *Trigynia*, and *Tetragynia*.
9. ENNEANDRIA, nine stamens, has three orders.	9. *Monogynia*, *Trigynia*, *Hexagynia*, with six ovaries.
10. DECANDRIA, ten stamens, has five orders.	10. *Monogynia*, *Digynia*, *Trigynia*, *Pentagynia*, and *Decagynia*, with ten ovaries.

11. Dodecandria, twelve stamens, has six orders.	11. *Monogynia*, *Digynia*, *Trigynia*, *Tetragynia*, *Pentagynia*, and *Dodecagynia*, with twelve ovaries.
12. Icosandria, with many, frequently twenty stamens, attached to the calyx. This class contains three orders.	12. *Monogynia*, *Di-pentagynia*, varying from two to five ovaries; and *Polygynia*.
13. Polyandria, many stamens, not attached to the calyx. This class contains five orders.	13. *Monogynia*, *Digynia*, *Trigynia*, *Pentagynia*, and *Polygynia*.

All the above classes have their stamens of equal length.

14. Didynamia, four stamens, two of which are long, and two short. This class contains two orders.	14. *Gymnosperma*, with naked seeds; and *Angiosperma*, with the seeds enclosed in a seed vessel.
15. Tetradynamia, six stamens, four of which are long, and two short. This class contains two orders.	15. *Siliculosa*, with the seeds enclosed in a silicle; and *Siliquosa*, with the seeds enclosed in a silique.

All the above classes have their stamens free and distinct.

16. MONADELPHIA, in which the stamens are all united into one column or bundle. This class was divided by Linnæus into seven orders, founded on the number of the stamens contained in each, and not like the other orders on the ovaries.	16. *Triandria* has three united stamens; *Pentandria* has five; *Heptandria*, seven; *Octandria*, eight; *Decandria*, ten; *Dodecandria*, twelve; and *Polyandria*, many.
17. DIADELPHIA, having the stamens in two bundles. Four orders.	17. *Pentandria*, *Hexandria*, *Octandria*, and *Decandria*.
18. POLYADELPHIA, having the stamens in many bundles. Four orders.	18. *Decandria*, *Dodecandria*, *Icosandria*, many stamens, attached to the calyx; and *Polyandria*, many stamens, not attached to the calyx.

In the above orders, the stamens are united by their filaments.

19. SYNGENESIA, having the stamens united by their anthers into a cylinder. In this class	19. *Æqualis*, in which the florets are all bisexual, that is, all have both stamens and pistils;

there are five orders, all of which are called Polygamia, because each flower contains many florets on one common receptacle, like the daisy. Linnæus added another order, called Monogamia, which had the anthers united in simple flowers, as in the case of the violet; but this is now abandoned.	*Superflua*, in which the florets of the disk are bisexual, but those of the ray have only pistils; *Frustanea*, in which the florets of the disk are bisexual, and those of the ray without either stamens or pistils; *Necessaria*, in which the florets of the disk have only stamens, and those of the ray only pistils; and *Segregata*, in which every floret has a separate calyx.
20. GYNANDRIA, having the stamens growing upon the pistil. Three orders.	20. *Monandria, Diandria,* and *Hexandria*.

In all the above classes the stamens and pistils are found in the same flowers.

21. MONŒCIA, having the stamens and pistils in different flowers, but on the same plant. There *are eight orders in this class.*	21. *Monandria, Diandria, Triandria, Tetrandria, Pentandria, Hexandria, Polyandria,* and *Monadelphia*.

22. DIŒCIA, having the stamens and pistils, not only in different flowers, but on different plants. There are fourteen orders in this class.	22. *Monandria, Diandria, Triandria, Tetrandria, Pentandria, Hexandria, Octandria, Enneandria, Decandria, Dodecandria, Icosandria, Polyandria, Monadelphia*, and *Gynandria.*
23. POLYGAMIA, having the flowers sometimes bisexual, and sometimes male and female on the same or on different plants. Two orders.	23. *Monœcia* and *Diœcia.*

All the above classes have visible flowers.

24. CRYPTOGAMIA, or flowerless plants, containing nine orders.	24. *Filices* (ferns); *Equisetaceæ*, (Dutch rush, and common horsetail); *Lycopodineæ*, (club moss); *Marsileaceæ*, (pepperwort); *Musci*, (mosses); *Hepaticæ*, (liverwort); *Algæ*, (sea-weed); *Lichenes*, (lichens); and *Fungi*, (mushrooms, etc.)

All these classes and orders are subdivided into genera, species, and varieties.

THE SYSTEM OF JUSSIEU.

Jussieu divided all plants into three great classes, viz.—

Acotyledons, or plants without any cotyledon or seed leaf, in which he included the ferns and mosses.

Monocotyledons, or plants with only one seed leaf, in which he included the grasses, the bulbous plants, and in short, all that have the veins of their leaves in parallel lines.

Dicotyledons, or plants with two seed leaves, which have leaves with reticulated veins.

The acotyledonous plants being few in number, were not subdivided, except into genera and species; but the monocotyledonous plants were redivided into three sub-classes, according as the stamens were *hypogynous, perigynous,* or *epigynous* (see p. 19). The dicotyledonous plants Jussieu divided into the *apetalous,* the *monopetalous,* and the *dipetalous;* and each of these were again divided into sub-classes, depending on the position of the stamens with regard to the ovary, and on their being united or distinct. Jussieu having thus made fifteen classes and sub-classes, proceeded to the arrangement of the orders, of which he made one hundred, which he divided among his classes, beginning with the fungi, as being the lowest in his scale of rank in the vegetable kingdom, and proceeding upwards to the coniferæ, which he placed last, as being, what he considered, the highest in the scale.

THE NATURAL SYSTEM,

AS MODIFIED BY PROFESSOR DE CANDOLLE.

When Professor De Candolle undertook the arrangement of the system of Jussieu, he first changed the succession of the orders; and instead of beginning with the ferns and mosses, he began with the most perfect of the dicotyledonous plants; viz. those possessing both a calyx and a corolla. According to this arrangement he made ranunculaceæ, or the crowfoot family, his first order, and the algæ, or sea-weed, his last. De Candolle retained the three great classes of Jussieu, but gave up the subdivisions; and substituting others for them, he redivided the dicotyledonous plants into two sub-classes, viz. the dichlamydeæ, or those which have both a calyx and a corolla, and the monochlamydeæ, or those which have only a calyx. The dichlamydeæ, De Candolle again divided into the thalamifloræ, which have the stamens growing from the receptacle from under the ovary (see fig. 20, in p. 19); the calycifloræ, which have the stamens attached to the calyx (see fig. 21, in p. 19); and the corollæfloræ, which have the stamens attached to the corolla (see fig. 22, in p. 19). The first two of these last subdivisions have polypetalous flowers, but the flowers of the last are monopetalous.

The monocotyledons, De Candolle subdivided into the *phanerogamous* plants, or those with visible flowers, such as the bulbs; and the *cryptogamic* plants, or those without visible flowers, such as the ferns; and the acotyledons, he subdivided into the *foliaceous*, or those with leaves, such as the mosses, and the *aphyllous*, or those without leaves, such as the fungi.

Since the promulgation of this system, however, several alterations have been made in it by adding new orders and dividing others, and altering the places of nearly all, by Professor De Candolle himself, in his *Prodromus;* by Sir W. J. Hooker, in his new edition of *Smith's Grammar of Botany;* by Dr. Lindley in his *Introduction to the Natural System, etc.*; by Professor Don in the *Edinburgh Philosophical Journal*, and by Mr. George Don, in his new edition of *Sweet's Hortus Britannicus*, till at last nearly three hundred orders have been made—a number far too great to be described in a work like the present.

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